FRD Activities Report
February 2002

Research Programs

CBLAST-Low

The LongEZ conducted three missions to compare satellite-based synthetic aperture radar (SAR) derived winds against surface layer winds acquired by the aircraft. SAR is being used to estimate surface winds (U) and friction velocities (u_*) over the oceans; however, validation is still needed. Under light wind conditions and smooth seas, SAR fails to provide solutions for U and u_*. These aircraft flights were acquired during the Coupled Boundary Layers Air-Sea Transfer light wind (CBLAST-Low) field study conducted over a three week period in July and August 2001 over the waters south of Martha's Vineyard. The purpose of these flights was to test the lower limits of SAR capabilities. Figure 1 depicts the LongEZ wind vectors plotted once every 60 s (~ 3 km) for missions flown in the early morning on July 22, August 1, and August 8. Vector-averaged wind speed and direction for these three days were 4.0 ± 1.0 m s^{-1}, 203 ± 17°, 4.0 ± 0.5 m s^{-1}, 299 ± 6°, and 4.0 ± 0.6 m s^{-1}, 242 ± 10°, respectively. We will be working with Don Thompson of the Johns Hopkins University on comparing the LongEZ winds and turbulence against SAR-derived counterparts. (Jerry.Crescenti@noaa.gov)

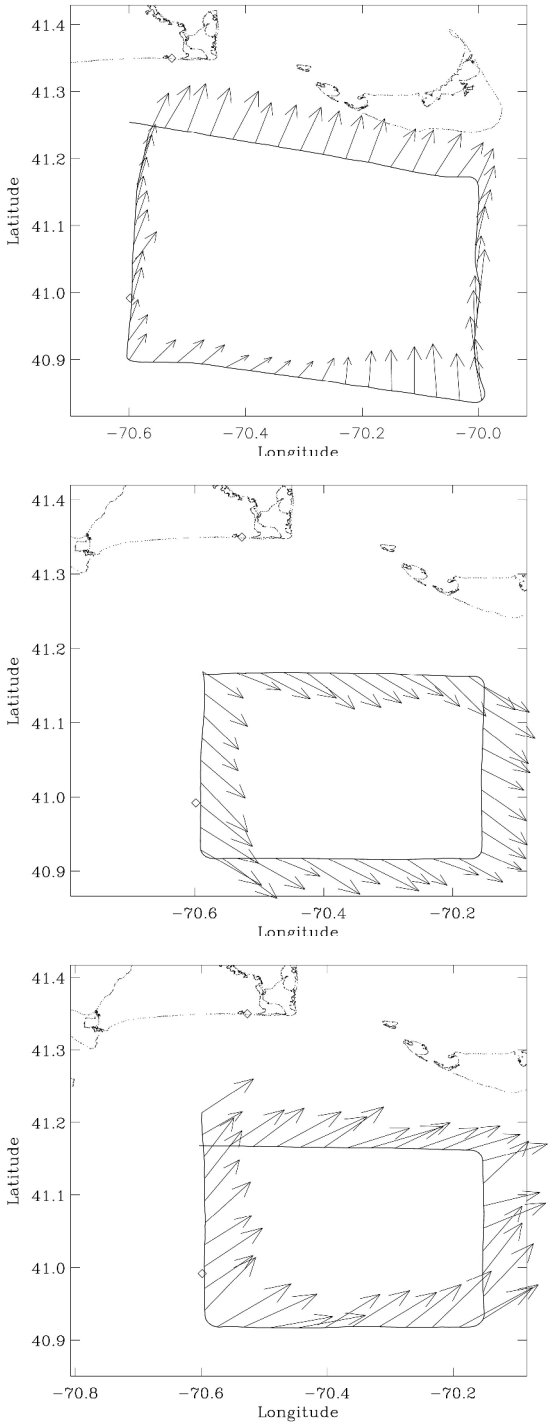

Figure 1. LongEZ winds.

Work has been completed on a new algorithm to determine a more accurate altitude measurement. It is estimated that the new value is accurate within ±10 cm. The new algorithm consists of removing the bad points and outliers from the three laser data measurements, converting the measurements to earth-based coordinates, and then averaging the three measurements to arrive at one good laser measurement, zlavg. The laser data is accurate at low altitudes while the GPS data is not. However,

the GPS data contains no wave effects. By taking 60 second averages of the difference between zlavg and the GPS data, an offset is computed that is applied to the GPS data. (Tami Grimmett)

VTMX/URBAN 2000

A case presented here exhibits an evolving drainage out of the Wasatch Mountains. Using data acquired by the LongEZ and a ground-based wind profiling system, we describe some suggestive aspects of its structure. The LongEZ flew several pre-dawn research missions during VTMX. In addition, a 10-m tower, phased-array Doppler sodar, and radar wind profiler acquired surface and upper-air meteorological data. These instruments were deployed 5 km southwest of downtown Salt Lake City. Wind speed and direction were recorded at 10 m while air temperature and relative humidity were measured at 2 m as 5-min averages. A Radian phased-array Doppler sodar acquired 15-min wind profiles from 40 to 300 m with a 10-m resolution. A Radian 915-MHz phased-array radar wind profiler acquired one-hour wind profiles in a dual sampling mode. The first mode acquired high-resolution, low-range data from 124 to 2158 m with a resolution of 55 m. The second sampling mode acquired low-resolution, high-range data from 172 to 3732 m with a resolution of 96 m.

The LongEZ flew a repeated 13-min north-south "racetrack" pattern at 400 m AGL on the eastern side of the Salt Lake Valley during the predawn hours of 26 October 2000. Figure 2 shows wind vectors acquired by the LongEZ for four sequential flight tracks over a 50-min period. The two north-south legs of the race track are separated by about 5 km. Relative magnitude of the turbulent kinetic energy (TKE) is represented by open circles. The wind vector from the radar at 400 m is also included 4 km west of the northwest corner of the track.

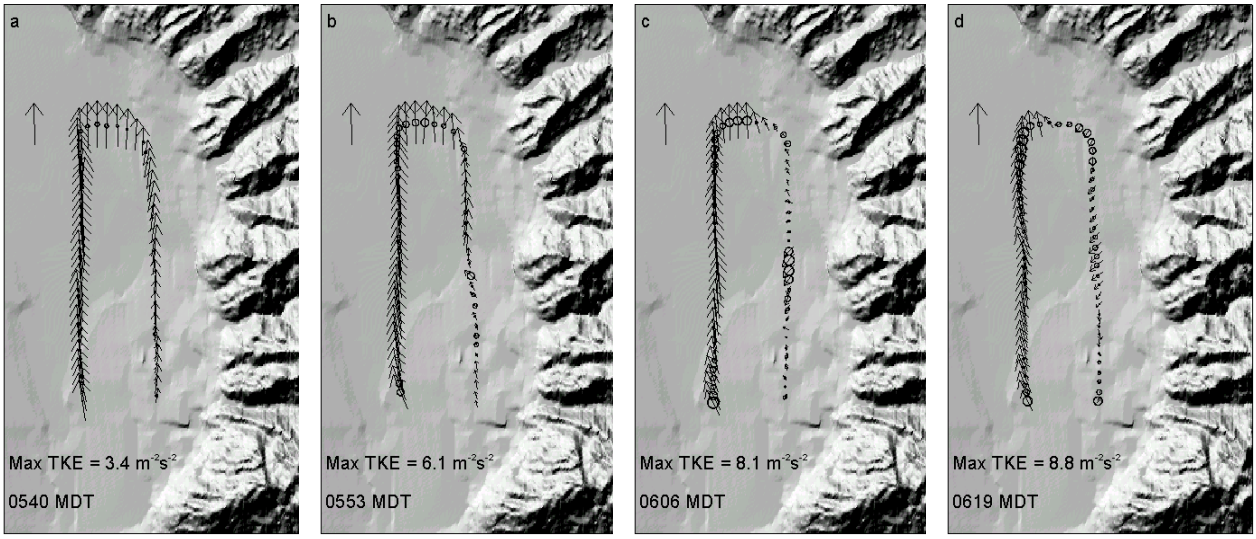

Figure 2. "racetrack".

Winds at flight level were from the south in the first period, centered at 0540 MDT. Winds were 12 m s^{-1} on the west side of the track with weak turbulence everywhere. On the 0553 track a weak southeasterly flow appeared along the east leg, with increased turbulence on the northwest

corner. By 0606, a moderate northeasterly flow and strong turbulence were encountered along the middle portion of the east leg. Turbulence also strengthened on the north end of the track. The turbulence increase is probably a combination of local generation and advection. The northeasterly drainage flow extended along most of the eastern leg by 0619 while turbulence intensity decreased. Strong turbulence appeared again on the northwest corner. The wind along the western leg remained at 10 m s^{-1} during the sampling period with a slight backing from the south to southeast with time. The wind opposite the mouth of Little Cottonwood Canyon at the southeast corner of the racetrack remained light and only weakly turbulent. The integrated tower, sodar, and radar data (Figure 3) show dominant southerly flow, 4 to 5 m s^{-1}, repeatedly interrupted by southeasterly flow in a surface-based layer which deepens beyond 100 m and then subsides. Such encroachments were centered on 0030, 0300, 0600, and 0800 MDT. Between these episodes, the southerly flow reestablished itself all the way to the surface at 0130, 0500, and 0700 MDT.

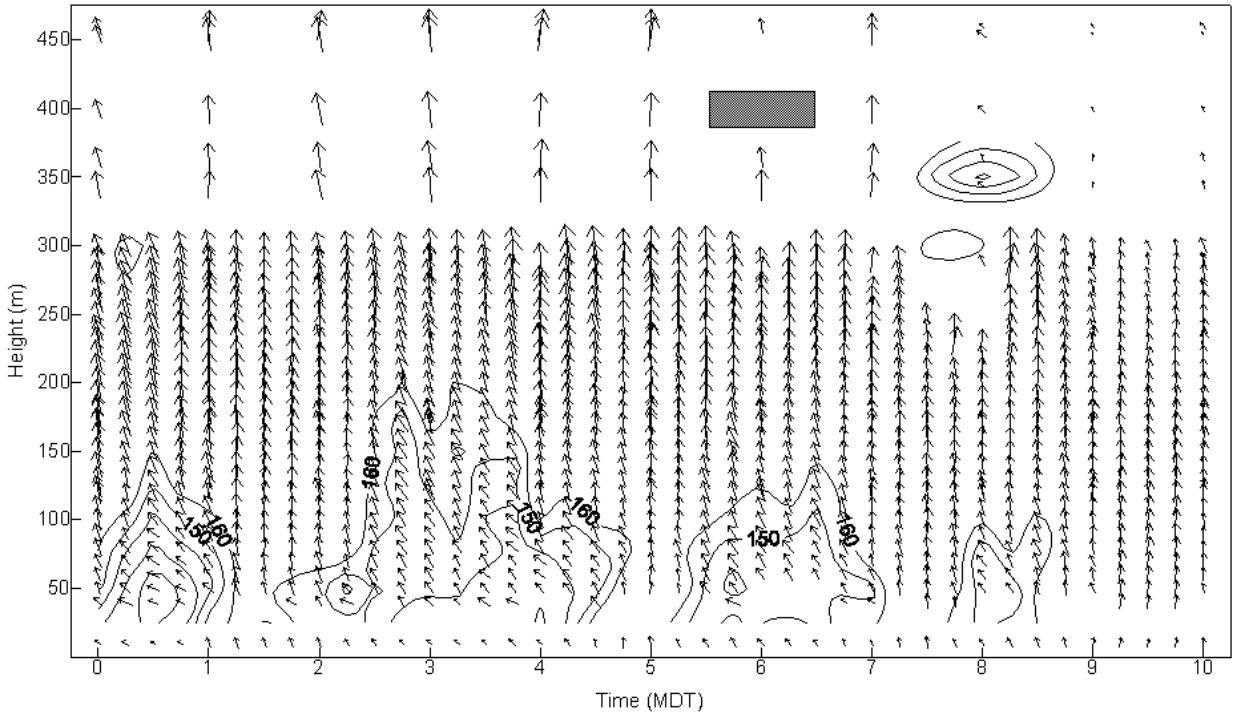

Figure 3. Time-height plot of tower, sodar, and radar wind, 26 OCT 00 (IOP 10). Isogon contour interval of 10 deg help depict apparent southeasterly drainage flows. Shaded box at 400 m from 0534-0625 MDT represents LongEZ sampling interval.

These data suggest an oscillating drainage flow. The airplane sampled the event centered on 0600 MDT. The east flight leg passed first above the drainage flow, then through the turbulent entrainment layer at its top, and finally within the drainage itself, characterized by northeast wind. The west flight leg, farther into the valley shows only south winds, though there was drainage beneath, revealed in the now southeast flow reported by the tower, sodar, and radar. Having a longer record, these instruments reveal the oscillatory nature of the drainage. More surface and upper air data from the whole Salt Lake Valley will be needed to verify these hypotheses. (Jerry.Crescenti@noaa.gov, Ron Dobosy, Ed Dumas)

CBLAST-High

Figure 4 shows a mount for the Infrared-Gas Analyzer (IRGA) that will be flown on the NOAA P3s during the upcoming hurricane season. The mount will be located in one of the down-facing windows, just aft of the nose of the aircraft. The IRGA and mount shown in Figure 4 will be flown this spring on the P3 as part of the Intercontinental Transport and Chemical Transformation (ITCT) Project as part of a joint agreement between ARL and Aeronomy Lab scientists.

Figure 4. Shane Beard displays the IRGA mount for the P3.

The IRGA is just one of a suite of instruments that ARL will mount this summer on the P3 to obtain measurements of moisture, temperature, and momentum flux in dry slots of hurricanes. Work continues on modifications to the data system that ARL will fly on the P3. Some of the changes include switching to a Linux-based system, integration of S-D boards to allow recording of INS output with the ARL data system, and updated display capabilities. (Jeff.French@noaa.gov, Shane Beard)

Refractive Turbulence Study

Preparations for the upcoming measurement campaign as part of the ongoing Refractive Turbulence Study are currently under way. During the March-April campaign, we will focus on turbulence created downwind of mountains in an attempt to measure various terms that comprise the TKE budget. Direct measurements of these terms is necessary, as we attempt to increase our prognostic capability for strong turbulence regions. Measurements will focus on temperature perturbations using the ARL-designed FUST probe, winds, and static pressure perturbations. Preparations to this point included preparing the data system and instrument calibration. (Jeff.French@noaa.gov)

Oklahoma City 2003 Tracer Test

A planning meeting with the major participants of the proposed Oklahoma City (OKC) tracer study was held 26-28 February in OKC. Representatives from DOE, DOD, DTRA, LLNL, LBNL, PNNL, and the University of Oklahoma as well as from NOAA ARL-FRD and ARL-ATDD were in attendance. Plans were made for a major deployment in July of 2003 to include mobile and stationary SF_6 samplers, radar wind profilers, sodars, and an extensive array of sonic anemometers and standard met stations to characterize the airflows in and around the city. The meeting also included discussions with the city engineer, who offered extensive help in making contacts with appropriate real estate owners and elected officials. Ion mobility spectrometry (IMS) was discussed as a means to improve tracer measurement in the vertical. Promises of providing one-half the IMS development costs were received from DOD if NOAA would match the investment. (Kirk.Clawson@noaa.gov and Ray Hosker)

Cooperative Research with INEEL

Emergency Operations Center (EOC)

As part of an upcoming drill at the INEEL Emergency Operations Center (EOC), FRD has been asked to develop an MDIFF release scenario involving puff releases extending over 48 hours. The current version of the model does not allow puff releases to extend more than 24 hours. A revised version of the model was therefore developed that removes the 24-hour release limitation. This version will be used together with special meteorological input files during the drill. (Richard.Eckman@noaa.gov, Roger Carter, Kirk Clawson)

INEEL Support

An INEEL-Viz and MDIFF training class was held at FRD on 11 February for personnel from INEEL and its contractors. The class provided an introduction into the operation of the INEEL-Viz interface and an overview of dispersion modeling and the MDIFF model. These classes are given on a regular basis as part of FRD's support to INEEL. (Brad Reese @noaa.gov, Richard Eckman)

As discussed in last month's activity report, FRD is conducting a statistical study of dispersion at INEEL using the MDIFF puff model and nine years of meteorological data from the Mesonet. The idea is to build up an ensemble of concentration estimates on the MDIFF grid by running consecutive pollutant releases over the nine years. Ten different release scenarios are being investigated, including four different release locations and elevated versus surface releases. Once the MDIFF runs were started, it quickly became clear that the task will require a considerable investment in time and computer resources. With nine years of data and ten release scenarios, it turns out that almost 800,000 runs of MDIFF are required to complete the project. Assuming one second per MDIFF run, this comes out to about nine 24-hour days just to run the model. The output from all these runs will occupy about 10 GB of disk space after compression. After all the runs are completed, the output will be used to generate concentration statistics on the MDIFF grid. (Richard.Eckman@noaa.gov)

In early February, Brad Salmonson at INEEL came to FRD with some questions related to the dose conversion factors used in MDIFF. These factors are used to convert a total integrated concentration (TIC) to a radiological dose in rem. Brad had found some of the original documentation on how the conversion factors were developed, but was getting some unexpected results when he compared MDIFF's TICs to the resulting doses. An investigation was made into how the model was actually using the conversion factors. It was determined that the model was using the factors correctly, but that the treatment of the model's source term differs when the model is run in TIC mode and in dose mode. In TIC mode, MDIFF treats in input source term as a release *rate*, but in dose mode this same variable is treated as the total *quantity* of material released. This different treatment of the source led to the unexpected results that Brad Salmonson had obtained. (Richard.Eckman@noaa.gov)

A meeting of the INEEL Water Board was attended on 28 February. This board is being set up as an advisory body for INEEL for programs that affect water at the site. The main focus is on ground and surface water, but FRD has a seat on the board because of its precipitation measurements and involvement in the INEEL Storm Water Program. (Richard.Eckman@noaa.gov)

New Interagency Agreement Still in Preparation

The DOE-ID has begun to move forward again in its creation of a new Interagency Agreement (IA) with FRD. As a consequence, a comprehensive 5-year statement of work (SOW) was prepared for inclusion in the IA. Of foremost importance in the document was the discussion of eroding purchasing power of the DOE-ID budget in the face of many years of flat funding. Increased funding at the rate of past inflation rates was included in the new SOW. (Kirk.Clawson@noaa.gov)

Profiler repair

Twice during the last month, the computer running the 900MHz radar profile located on the INEEL has required repair. The first time, the network card failed leaving us unable to communicate with the system. Since the profiler facility can not be driven to in winter, Tom Strong skied to the building and skied out with the damaged computer in a back pack. The next day, the repaired computer was returned the same way. Later in the month, the UPS failed and a recurred CMOS error brought the system down again. This time, Tom was able to drive part way to the building but had to walk the last couple hundred yards. He was able to replace the UPS and make some temporary repairs to get the computer going again. Plans are now underway to replace the 8 years old computer. (Tom Strong@noaa.gov, Roger Carter)

Other Activities

At the request of the Office of Marine and Aviation Operations (OMAO), GSA's Interagency Committee for Aviation Policy (ICAP) carried out a Aviation Resource Management Survey (ARMS) of our research programs utilizing the LongEZ. In addition to the usual thirteen review areas, OMAO specifically requested the ARMS include a comprehensive risk analysis, suggest how to best continue the use from a administrative standpoint, and identify other aircraft options suitable to perform the research. We were pleased that the ARMS Team recognized the outstanding mission effectiveness of a "pusher" type aircraft not only for gathering air data but for its fuel efficiency, operating costs, and endurance

Major report conclusions were:

- LongEZ N3R is operated and maintained in accordance with all applicable Federal Aviation regulations;
- The pilots that fly the Long EZ meet and comply with all applicable Federal Aviation regulations;
- The operation of the Long EZ by the FRD is safe and efficient, and appears to be quite cost effective; and

- NOAA would be better served if it were to have operational control of flight operations conducted by FRD.

Major report recommendations included:

- AOC should place the Long EZ under their operational control;
- FRD should maintain functional control and continue to develop a LongEZ specific operations manual; and
- AOC should obtain future aircraft as a joint decision between the FRD, NOAA, and the AOC. (Tim.Crawford@noaa.gov)

Training-Retirement Seminar

Judy Snow, a financial/estate planner who specializes in working with federal employees, gave the "Pre-Retirement Seminar for FERS Federal Employees" at FRD on February 6. All FRD employees (and some spouses) in the FERS program attended the seminar. (paula.fee@noaa.gov)

Proposals

Mini-Doppler Sodar for Transport and Diffusion Research by Gennaro H. Crescenti. Submitted to the NOAA/OAR Assistant Administrator's Discretionary Fund (AADF).

Analysis of CO_2 Flux Spatial Variability over Coastal Waters by Gennaro H. Crescenti and Timothy L. Crawford. Letter of Intent submitted to the NOAA Climate and Global Change Program, Global Carbon Cycle Element.

Cost Effective Observations for Climate Research in Continental USA by Jeff French, Tim Crawford and John Deluisi. Submitted to the NOAA/OAR Assistant Administrator's Discretionary Fund (AADF).

Establishment of Formal Safety Programs for NOAA ARLFRD Light Aircraft Operations by Tom Watson and Tim Crawford. Submitted to the NOAA/OAR Assistant Administrator's Discretionary Fund (AADF).

Modifications to the NOAA Twin Otter for improved scientific electrical power and mounting points for particle probes by Thomas B. Watson, Winston Luke, and Richard Artz. Submitted to the NOAA/OAR Assistant Administrator's Discretionary Fund (AADF).

Midwest Tower and Airborne Flux Program by Thomas Watson, Tilden Meyers, and Timothy Crawford. Submitted to the NOAA Climate and Global Change Program, Global Carbon Cycle Element.

Papers

Dobosy, R. J., E. J. Dumas, and G. H. Crescenti, 2002: Katabatic flow and turbulence as seen from airborne in-situ measurements and ground-based profiler measurements during VTMX. Preprint, *Fourth Symposium on the Urban Environment*, Norfolk, VA, May 20-24, Amer. Meteor. Soc., paper 12.6, submitted.

Griffiths, I. H., D. R. Brook, D. J. Hall, A. Berry, R. D. Kingdon, K. L. Clawson, C. Biltoft, J. M. Hargrave, C. M. Clem, D. C. Strickland, and A. M. Spanton, 2002: Urban Dispersion Model (UDM) validation. Preprint, *Fourth Symposium on the Urban Environment*, Norfolk, VA, May 20-24, Amer. Meteor. Soc., paper J1.13, submitted.

Brook, D. R., I. H. Griffiths, D. J. Hall, A. Berry, R. D. Kingdon, K. L. Clawson, C. Biltoft, E. Yee, J. M. Hargrave, C. M. Clem, D. C. Strickland, and A. M. Spanton, 2002: Validation of the Urban Dispersion Model (UDM). Preprint, Eight International Conference on Harmonisation with Atmospheric Dispersion Modelling for Regulatory Processes, Sofia, Bulgaria, 14-17 October 2002, in preparation.

Papers Reviewed

Min, I. A., R. N. Abernathy, and H. L. Lundblad, 2002: Measurement and analysis of puff dispersion above the atmospheric boundary layer using quantitative imagery. *J. Appl. Meteor.*, reviewed by Jerry Crescenti.

Isaac, P. R., J. McAneney, R. Leuning, J. M. Hacker: 2001: Comparison of aircraft and ground based flux measurements during OASIS95. *Bound.-Layer Meteor*., reviewed by Tim Crawford.

Travel

Jeff French and Tom Watson to Boulder, Colorado, February 7-10, to pick up instruments from ARL SSRB and discuss experiments with scientists in the Aeronomy Laboratory.

Kirk Clawson, Oklahoma City, February 24-March 3, to attend the planning meeting for the proposed Oklahoma City tracer study in July, 2003.